1975

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A.S. Series 75-23

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The effect of body size on feed efficiency has been the subject of research for several years. Evidence was presented from some of the early research that body weight is unrelated to feed efficiency. Recent research has also shown that current recommended net energy requirements, such as those by the National Research Council, for growing and finishing beef cattle are valid for various sizes and types of beef animals. Large-bodied cattle gaining at a faster rate require more feed and should be fed to heavier weights to reach best market grade.

Animal performance and time needed to reach various market weights can be changed by the amount of roughages and concentrates in rations and by length of time of feeding high-roughage and high-concentrate rations in a two-phase system involving a growing, or backgrounding, phase and a high-concentrate finishing phase. More information is needed on the comparative performance of cattle that vary in potential adult size under systems of feeding using rations containing various levels of roughages and concentrates or using varying intervals of high-roughage and high-concentrate feeding. Such information would be useful in selecting rations and feeding systems that result in optimum weight gains and best use of feeds to reach desirable market weight for size of cattle involved.

The experiment reported here was designed to compare two groups of cattle with different potential adult size when fed rations which varied in energy contents and when marketed after different times of finishing. Angus x Hereford steers were used to represent one size and Charolais x Hereford the other.

## Procedures

Specific objectives of the experiment were:

1. To compare high-energy and low-energy diets as to feedlot performance and carcass characteristics of feedlot steers.

2. To determine effects of final market weight on feedlot performance and carcass characteristics of steers fed under two dietary regimens.

3. To determine the influence of potential mature body size of cattle on feedlot performance and carcass characteristics under variable conditions as to energy concentration of diets and market weights of cattle.

## Cattle and Feeds

Sixteen pens each with eight steers were used in the experiment. Variation in potential adult size was represented by a Angus x Hereford (AH) group and a Charolais x Hereford (CH) group (8 pens of 8 each for each breed group).

The steers were purchased in the spring after having been wintered in a good thrifty condition. They were purchased over a period of about 1 month. Upon arrival and prior to the beginning of the experiment, they were fed a ration of 5 lb. corn grain and a full feed of alfalfa-brome hay or haylage. All cattle were vaccinated for prevention of blackleg and implanted with 36 mg zeranol shortly after beginning of the experiment.

Allotment to the experiment was on basis of weight within breed group. A high-energy diet (2 lb. roughage air-dry matter, ADM) or a low-energy diet (10 lb. roughage ADM) was offered to four pens of steers within each breed group. Two of the four pens were fed chopped alfalfa-brome hay and two pens were fed alfalfa-brome from the same source with water added and stored as reconstituted haylage.

Corn grain was fed to appetite with each level of roughage. It was purchased as dry grain. Water was added and the corn stored as reconstituted high-moisture grain (about 27% moisture). Considerable cracking of the grain occurred when blowing into the silo. No further processing was used for the grain.

A soybean meal-corn supplement (22% protein) was fed at 2 lb. per head daily with the low level of forage (estimate about 11% protein in ration). No supplemental protein was considered necessary with the higher level of forage. However, a supplement of corn with added minerals, vitamin A and chlortetracycline was fed at 2 lb. per head daily. Ingredient composition of supplements are shown in table 1.

The cattle on the higher level of forage were started at the 10 lb. level (ADM) and 2 lb. of supplement with corn grain at 5 lb. per head. The corn grain was increased by 1 lb. per head daily to a full feed. The cattle on the lower level of forage were started on feed at the same levels as above. The forage was reduced by 1 lb. (ADM) per head daily to the 2 lb. level. Corn was increased by 1 lb. daily to a full feed. After obtaining a full feed, corn was fed to appetite with constant levels of forage and supplement. Feeding was once daily in outside, paved pens.

## Weight Groups

The cattle within each breed and energy level group were marketed at two final weights. The AH group was used to set these points. It was planned to market weight group 1 when the average feedlot weight of the AH steers averaged about 1050 pounds. The planned feedlot weight for marketing AH steers in weight group 2 was about 1200 pounds. CH steers in the two weight groups were marketed at the same time as the AH steers.

The two weight groups for each breed and energy level were fed in the same pens until time of marketing for those in weight group 1. At this time four of the eight steers were marketed. The remaining steers in each pen were continued on the same feeding program for the weight group 2 phase of the experiment. Carcass data were obtained upon slaughter.

## Results

Results of the experiment are shown in table 2. The cattle in weight group 2 which received the lower energy ration and fed for the longest time were weighed on January 7 after 236 days on experiment. There was a severe blizzard on January 10 and 11. The cattle were fed in the usual manner on January 10 but feeding was not possible the next day. For the following two days, the cattle were full-fed alfalfa-brome hay and shipped to market on January 14.

The decision to market as soon as the cattle could be shipped following the blizzard was made in view of the closeness of the January 7 weight to the planned market weight and amount of shrink expected from the weather conditions. Because of these conditions, it was considered advisable to base the weight gain on carcass weights with the final live weight calculated on basis of a constant dressing percent. A yield of 62% was used. Weight gain and feed efficiency data for all treatment groups were calculated on this basis.

### Weight Gain

Average weight of the AH steers was 563 lb. at the beginning of the experiment in comparison to 619 lb. for CH steers. Selection was made to obtain steers which appeared to have similar backgrounding treatment rather than similar weight between breed groups.

The cattle in weight group 1 and fed the higher energy ration were marketed after 146 days. Average weight of AH steers was 1008 lb. with an average daily gain of 3.06 pounds. CH steers marketed at this time had gained 0.29 lb. (9.5%) more daily.

Weight gains were reduced by feeding to the heavier market weight with the high-energy ration. Average weight of the AH steers when marketed was 1197 lb. and the average daily gain was 2.92 pounds. This represents a reduction over the total days of 4.6% in comparison to weight group 1. However, assuming similar gains for the two weight groups up to point of marketing weight group 1, the reduction thereafter would amount to 14.1%. CH steers showed similar reductions in rate of gain when fed to the heavier weight as did AH steers. There appeared to be no difference between the two breed groups in this characteristic.

Lower weight gains were encountered with the lower energy rations for each breed group of steers. Within breed group, the weight gain reduction from weight group 1 to weight group 2 was about the same as for the higher energy ration (approximately 4 to 5% for each group). Reductions in weight gain with the lower energy ration amounted to 13.7 and 12.7%, respectively, for the two weight groups of AH steers. For CH steers, the reductions amounted to 19.1 and

20.2%, respectively, with the lower energy ration at the two weight groups. The advantage in weight gain for CH steers over AH steers with the high energy ration was not apparent with the lower energy ration at either weight group.

Feed Data

CH steers consumed more feed than did AH steers. While there was a greater intake of feed with the lower energy ration, the amount of increase by each breed group was similar. Feed intake decreased when fed to the heavier weights with no major differences between type of ration or breed groups of cattle.

Higher rates of gain for CH steers associated with the higher intake of feed resulted in only small differences between the two breed groups in feed efficiency with the higher energy ration. Even though weight gains were lower when fed to the heavier weights, the reduction in feed intake resulted in similar feed efficiency for the two weight groups.

Lower rates of gain with higher feed intakes with the lower energy ration resulted in pronounced increases in feed requirements for both groups of cattle at each market weight. While there was a slight increase in overall feed requirements at the heavier weights, it was about the same in magnitude (2.6%) for each group of steers.

Carcass Characteristics

AH steers graded higher than CH steers. Differences were greater for the higher energy ration and for the longer time on feed. The differences in carcass grading were primarily a reflection of amount of marbling. AH steers had more marbling in all breed group comparisons within type of rations and days fed. However, response in amount of marbling to energy level of rations and days fed was similar for the two breed groups, except for CH steers fed the lower energy ration.

Amount of kidney fat as percent of carcass weight was similar for the two groups of cattle. It was slightly higher for each weight group when fed the lower energy ration. Fat thickness showed only small effects from rations or days fed. However, AH steers had the most fat covering.

CH steers had larger rib eyes but carcasses were heavier when marketed after the same number of days on feed. When fed the higher energy ration, the heavier market weight resulted in larger rib eyes. This effect was not evident with the lower energy ration with either breed group of cattle.

## Summary

Effects of energy level of rations and market weight on feedlot performance and carcass characteristics were studied with two groups of cattle which varied in potential mature size, Angus x Hereford (AH) and Charolais x Hereford (CH). Comparisons were made between rations with 2 lb. and 10 lb. of forage (ADM) with 2 lb. of supplement and corn grain fed to appetite. Feeding periods were 146, 174, 216 and 236 days for various rations and market weights with cattle from each breed group marketed at each time.

Results of the experiment show an advantage on basis of weight gain for the larger type cattle when fed the higher energy ration (2 lb. forage ADM). While there was a reduction in rate of gain with the lower energy ration (10 lb. forage ADM), there were only small differences between two breed groups. It would appear that large-bodied cattle capable of making a fast rate of gain benefit more from high-energy rations.

The larger cattle consumed more feed resulting in only small differences in feed efficiency between the two breed groups. Feed requirements were increased more for the lower energy ration when fed to the heavier weights. However, the lower energy ration resulted in rather small savings in total concentrates per unit of forage on basis of feed efficiency for weights of cattle in this experiment.

AH steers had more marbling and a higher carcass grade but with a smaller rib eye and more fat covering. Marbling and carcass grade were improved at the heavier marketing weight by the higher energy ration with these effects being slightly more evident with AH steers.

Table 1. Ingredient Composition of Supplements

| Ingredient | Low energy diet (10 lb. roughage ADM) % | High energy diet (2 lb. roughage ADM) % |
|---|---|---|
| Ground corn grain | 94.58 | 44.58 |
| Soybean meal (44% protein) | --- | 40.00 |
| TM salt | 3.00 | 3.00 |
| Limestone | --- | 9.00 |
| Disodium phosphate | 2.00 | --- |
| Potassium chloride | --- | 3.00 |
| Vitamin A premix (10,000 IU/lb. supplement) | 0.07 | 0.07 |
| Aureomycin-10 (35 mg CTC/lb. supplement) | 0.35 | 0.35 |

Table 2. Feedlot Performance and Carcass Characteristics as Affected by Energy Content of Diets, Market Weight and Types of Cattle

| | High energy diet | | | | Low energy diet | | | |
|---|---|---|---|---|---|---|---|---|
| | A x H | | C x H | | A x H | | C x H | |
| | Wt. 1 | Wt. 2 | Wt. 1 | Wt. 2 | Wt. 1 | Wt. 2 | Wt. 1 | Wt. 2 |
| Number of animals | 16 | 15 | 16 | 14 | 16 | 16 | 15 | 16 |
| Number of days fed | 146 | 216 | 146 | 216 | 174 | 236 | 174 | 236 |
| Init. shrunk wt., lb. | 562 | 566 | 621 | 616 | 561 | 564 | 621 | 618 |
| Adj. final wt., lb. | 1008 | 1197 | 1111 | 1310 | 1021 | 1166 | 1092 | 1224 |
| Avg. daily gain, lb. | 3.06 | 2.92 | 3.35 | 3.21 | 2.64 | 2.55 | 2.71 | 2.56 |
| Avg. daily ration, lb. | | | | | | | | |
| Hay or haylage | 3.20 | 2.99 | 3.20 | 2.98 | 13.52 | 13.20 | 13.52 | 13.22 |
| Corn grain | 20.17 | 19.37 | 22.37 | 21.26 | 14.62 | 14.85 | 15.52 | 15.43 |
| Supplement | 1.99 | 2.00 | 1.99 | 2.00 | 1.99 | 1.99 | 1.99 | 1.99 |
| Total | 25.36 | 24.36 | 27.56 | 26.24 | 30.13 | 30.04 | 31.03 | 30.64 |
| Feed/100 lb. gain, lb. | | | | | | | | |
| Hay or haylage | 105 | 103 | 96 | 93 | 523 | 526 | 519 | 520 |
| Corn grain | 660 | 663 | 668 | 662 | 559 | 584 | 577 | 603 |
| Supplement | 65 | 69 | 59 | 62 | 76 | 78 | 74 | 78 |
| Total | 830 | 835 | 823 | 817 | 1158 | 1188 | 1170 | 1201 |
| Hot carcass wt., lb. | 625 | 742 | 689 | 812 | 633 | 723 | 677 | 756 |
| Conformation[a] | 21.5 | 22.4 | 20.9 | 21.7 | 20.4 | 21.5 | 20.1 | 20.4 |
| Marbling[b] | 6.9 | 8.5 | 5.3 | 6.6 | 6.3 | 7.8 | 5.7 | 5.8 |
| Carcass grade[a] | 20.6 | 22.0 | 19.0 | 20.2 | 19.7 | 20.8 | 19.4 | 19.5 |
| Color[c] | 5.0 | 4.8 | 4.7 | 4.3 | 5.2 | 4.7 | 4.6 | 4.4 |
| Firmness[d] | 5.3 | 6.0 | 5.1 | 5.8 | 5.8 | 6.3 | 5.3 | 5.6 |
| Percent kidney fat | 3.0 | 3.1 | 2.9 | 3.0 | 3.4 | 3.6 | 3.3 | 3.6 |
| Rib eye area, sq. in. | 10.83 | 11.45 | 11.97 | 13.12 | 11.38 | 10.95 | 12.38 | 12.15 |
| Fat thickness, in. | 0.61 | 1.02 | 0.43 | 0.65 | 0.55 | 0.94 | 0.48 | 0.64 |

[a]Prime = 23, Choice = 20, Good = 17. Graded to one-third grade.
[b]Moderately abundant = 9, slightly abundant = 8, moderate = 7, modest = 6, small = 5.
[c]Higher number represents darker meat.
[d]Higher number represents firmer meat.